

FOR A FEW HOWARDITES MORE: GRAND MAPS THE ELEMENTAL COMPOSITION OF VESTA.

T.H. Prettyman¹, R.C. Reedy¹, D.W. Mittlefehldt², N. Yamashita¹, D.J. Lawrence³, A.W. Beck⁴, W.C. Feldman¹, T.J. McCoy⁴, H.Y. McSween⁵, M.J. Toplis⁶, O. Forni⁶, H. Mizzon⁶, C.A. Raymond⁷, C.T. Russell⁸, C.A. Polanskey⁷, S.P. Joy⁸, J. Mafi⁸, and the Dawn Science Team. ¹Planetary Science Institute. E-mail: prettyman@psi.edu, ²NASA Johnson Space Center. ³Johns Hopkins University Applied Physics Laboratory. ⁴Smithsonian Institution. ⁵University of Tennessee. ⁶University of Toulouse. ⁷Jet Propulsion Laboratory. ⁸University of California Los Angeles.

Introduction: Dawn's Gamma Ray and Neutron Detector (GRaND) successfully completed Low Altitude Mapping Orbit (LAMO) at Vesta. Over four months were spent acquiring data in a 460-km radius orbit around Vesta (265-km mean radius). In LAMO, strong signatures from Vesta were observed for gamma rays and neutrons. We present preliminary abundances, detection limits, and global maps of the elemental composition of Vesta.

GRaND overview: A complete description of GRaND is provided by [1]. The instrument is deck-mounted and contains a compact arrangement of 21 sensors, including a bismuth germanate scintillator for high-efficiency gamma ray spectroscopy up to 10 MeV, capped by a higher-resolution cadmium zinc telluride array for gamma rays below 3 MeV, and surrounded by loaded scintillators that measure thermal, epithermal, and fast neutrons. By combining gamma ray and neutron spectroscopy data, measurements of specific elemental abundances such as Fe, Mg, and Si, and constraints on elemental abundances, including the average atomic mass and neutron macroscopic cross sections can be made. GRaND is sensitive to the chemistry of the bulk regolith (within a meter of the surface) and regional scales (a few hundred km). An overview of measurement fundamentals, analytical methods, and data sets are presented.

Science objectives: Vesta underwent igneous differentiation to form a core, crust and mantle and is recognized as the progenitor of the howardite, diogenite, and eucrite (HED) achondritic meteorites [e.g., 2]. The principle aim of the GRaND investigation is to study the geochemistry of Vesta and provide context for the HEDs. GRaND will determine the mixing ratios of HED whole-rock end-members in Vesta's regolith [1,3] and search for compositions under-represented in the meteorite collection, including evolved lithologies [4], mantle and lower crustal materials, possibly exposed in large basins [5], and volatile, H-bearing materials [1]. GRaND's nuclear measurements of elemental composition complement the visible to near IR measurements of mineralogy by VIR and FC [6,7]. For example, it should be possible for Dawn's instrument suite to determine the proportions of pyroxene and plagioclase, with GRaND constraining the latter [1]. Synthesis of these data sets is just beginning and will accelerate as Dawn departs for Ceres in August 2012.

Dawn is a NASA Discovery Mission led by the University of California, Los Angeles (UCLA).

References: [1] Prettyman, T.H. et al. 2011. *Space Science Reviews*, 163(1): 371-459. [2] McSween, H. et al. 2011. *Space Science Reviews*, 163(1):141-174. [3] Usui, T. et al. 2010. *Meteorit. Planet. Sci.*, 45(7):1170-1190 [4] Barrat, J.A., et al. 2009. *Meteorit. Planet. Sci.*, 44(3):359-374. [5] Beck A.W. and McSween, H.Y. (2010). *Meteorit. Planet. Sci.*, 45(5):850-872. [6] De Sanctis, M.C. et al. 2012. *Science* 336:697. [7] Reddy, V. et al. 2012. *Science* 336:700.